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JOB PROGRESS REPORT

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Job Title Snowmobile Harassment of Mule Deer on Cold Winter Ranges

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ABSTRACT

An implanted heart-rate telemetry system was placed in 2 male, semi-tame mule deer. Heart-rates of these deer were monitored during various daily activities while deer were at pasture. The telemetry system generally performed well but artifact problems prevented obtaining accurate heart-rates for walking, running, and some grazing activities. While at pasture these deer were harassed by 1 person, 2 persons, person plus a dog, and a snowmobile moving on prescribed routes at varying distances from the pasture. Deer reacted to harassment and heart-rate was found to be a sensitive measure of deer reactions to harassment.

SNOWMOBILE HARASSMENT OF MULE DEER ON COLD WINTER RANGES

David J. Freddy

The expanding human population is continually encroaching upon wildlife populations. There appears to be two primary effects of this encroachment; direct loss of wildlife habitat to development and harassment of wildlife populations.

Geist (1971) describes harassment as any activity of man that influences animals, such that animals increase their energy demands (calories needed to survive and reproduce) above normal. Repeated often enough, harassment may cause animals to draw abnormally upon body energy reserves, or consume increased amounts of limited forage. This increased "cost of living" would be immediately detrimental to the individual and in the long run, detrimental to the population. Pregnant females may abort or resorb young or die because of resulting nutritional deficiencies or physiological stresses. Populations may respond to harassment by shifting their distribution or eventually being eliminated.

Harassment may be more critical at certain times of the year. Winter is considered the critical season for survival of mule deer (Odocoileus hemionus) in the central Rocky Mountains. Limited winter ranges and limited amounts of quality forage place nutritional burdens upon deer. Any activity that forces deer to abandon their normal routines of behavior, movement and range utilization may increase the caloric energy needed for deer to survive.

The snowmobile is a potential source of harassment to mule deer in Colorado. Few deer winter ranges are exempt from snowmobile activity. These ranges are often associated with heavily traveled highways or adjacent to human population centers which increases the susceptibility of deer to snowmobile harassment.

Previous studies on the effects of snowmobiles on deer are limited in number. Eckstein and Rongstad (1973) radio-collared white-tailed deer (Odocoileus virginianus) and monitored deer responses to snowmobile traffic. Home ranges of deer did not significantly vary when snowmobiles were present nor did snowmobiles appear to upset the daily movement patterns of deer. However, deer did move away from snowmobile trails in response to the disturbance. Dorrance et al. (1975) also studied white-tailed deer and utilized radio telemetry to monitor deer responses to snowmobiles. Home ranges of individual deer tended to increase in size, although not significantly, in response to snowmobiles. Deer appeared to shift their activities away from snowmobile trails and increase their movements in response to snowmobiles. The authors felt that deer become somewhat habituated to snowmobile activity but that in critical winters any disturbance by snowmobiles eliciting a response by deer could seriously upset the energy budgets of individual animals.

Although these studies using telemetered deer give insight into deer behavior resulting from contact with snowmobiles, no quantitative estimate

of the energy cost of harassment is possible from this type of study. An estimate of the energy expenditure of the reactions of deer to snowmobiles is needed to quantitatively describe the effects of harassment.

Several approaches have been utilized to estimate energy expenditure in wild and domestic ruminants. Respiratory gas exchange methods have been used to estimate energy expenditure in grazing animals (Young and Corbett 1968, Corbett et al. 1969). However, this technique requires the animal being studied carry awkward equipment under restrained conditions and therefore difficult to use in a free ranging situation. Also, the use of radio isotopes, primarily a form of labeled CO_2 , in injection or infusion techniques appears to give reliable estimates of energy expenditure (Young et al. 1969, White and Leng 1968, Corbett et al. 1971). However, the infusion process may not be reliable during cold winter temperatures common to deer winter ranges. A technique to estimate energy expenditure that appears favorable is heart-rate. Recent advances in micro-biotelemetry have provided easily obtainable external and internal heart-rate radio transmitters. These transmitter systems place minimal restraints on free ranging animals.

Heart-rate has been monitored in man and wild animals and related to metabolic rate and heat production, or energy expenditure (Wyndham et al. 1959, Booyens and Hervey 1960, Webster 1967, Datta and Ramanathan 1969, Bradfield et al. 1969, Morhardt and Morhardt 1969, Owen 1969). Jacobsen (1973) summarizes published estimates of heart rate-energy expenditure relationships for various animals and presents an equation, based on these estimates, for predicting energy expenditure in deer using heart-rate. The equation:

$$Y = -1.0653 + 0.09371 (X)$$

where (Y)= rate of energy transaction in $kcal/kg^{.75}/hour$

and, (X)= heart rate in beats/minute

could be used to estimate the energy expenditure imposed on deer by snowmobile harassment.

With the availability of telemetry equipment and the apparent relationship between heart-rate and energy expenditure, the effect of harassment in terms of energy cost might be estimated. Responses of deer to snowmobile activity can be monitored and concurring energy costs estimated.

This study is being conducted in cooperation with the U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Laramie, Wyoming under Cooperative Agreement No. 16-671-CA.

P.N.O. OBJECTIVE

Evaluate whether snowmobile activity on winter ranges inhabited by deer decreases the ability of deer to survive winter by modifying the activities of deer so as to significantly increase energy expended.

SEGMENT OBJECTIVES

1. Monitor heart-rates of deer during various daily activities to quantify the energy costs of these activities during winter.
2. Ascertain activities of deer responding to prescribed snowmobile harassment.
3. Evaluate observed reactions of deer to snowmobiles in terms of appropriate heart-rate measurements and corresponding energy costs.
4. Evaluate the energy cost of snowmobile harassment to deer in relation to the total estimated energy budget of deer (concurring study).
5. Examine alternatives to minimize potential detrimental effects of snowmobiles on deer.

METHODS AND MATERIALS

Two semi-tame, male castrate mule deer, age 2-1/2 years, were equipped with implanted heart-rate monitoring transmitters. The telemetry system was essentially the same as that reported by Cupal et al. (1974) (Figs. 1, 2).

Surgery for implanting transmitters proceeded as follows: 1) animal was anesthetized with Rompum, intramuscularly, and Ketamine, intravenously, 2) hair was shaved at the base of neck and top and bottom of sternum, 3) hair and skin were aseptically cleansed, 4) subcutaneous incisions were made at the base of neck and sternum areas, 5) blunt dissection was performed within the neck incision to prepare a pouch for transmitter implant, 6) a catheter (large gauge hypodermic needle) was rammed subcutaneously from the incision at the top of the sternum to the neck incision, 7) electrodes were fed into the catheter and the implant placed in the pouch, 8) catheter removed (electrodes now surfaced at the top sternum incision, and rammed subcutaneously from the bottom to the top sternum incision, 9) electrodes fed into catheter, catheter removed, electrodes at bottom sternum incision (Fig. 3), 10) antibiotic salve placed into incisions, incisions sutured, and animal given large dose of penicillin. Surgery resulted in one electrode within the tissue at both the top and bottom of the sternum. Electrodes were not affixed to tissue but simply pushed into sternum tissue. Aseptic procedure was followed.

These deer were placed in a 10 acre pasture of native sagebrush winter range located at Junction Butte Research Center, Middle Park, Colorado. Animals were visually and telemetrically monitored from a glass enclosed tower adjacent to the pasture (Fig. 4). From 7:00 AM to 5:30 PM for two, 5 consecutive day trials in February, heart-rates and corresponding activities were monitored. Heart-rates and activities were sampled during 3, systematically spaced 10 minute intervals per hour. Deer sampled were alternated every other 10 minute interval, with the first deer sampled each day chosen at random. Activities were classified as bedded, bedded plus rumination,

standing, standing plus grazing, walking, walking plus grazing, running, alert reaction bedded, and alert reaction while up. This approach will allow examination of the variability in heart-rate due to deer, activity, trial, and time-of-day. Deer fed primarily on native forage but were occasionally given grain supplement.

While at pasture, deer were harassed by a snowmobile, people, and a person and dog moving on prescribed routes at varying distances from the pasture. Deer activities and heart-rates were monitored for 5 minutes prior to, during, and for 5 minutes after each harassment activity.

Heart-rates were determined directly from strip-chart recordings using a Hewlett-Packard Model 9820A digitizer-calculator system.

RESULTS AND DISCUSSION

Heart-rates for deer activities and harassment reactions are still being determined.

The telemetry system generally performed satisfactorily. However, problems exist and the system needs refinement. Initially, heart-pulse signal was being lost when the animals were in a head-down feeding position. The transmitting range of the implant was about 12-14 inches and, when the transceiver neck-collar slid down the neck beyond the implant's transmitting range, the signal was lost. A sustaining collar about 7 inches wide made of vinyl-coated cotton webbing lined with poly-sponge was buckled around the neck in front of the transceiver collar. This kept the transceiver collar close to the implant so signal was not lost during feeding (Fig. 5). The extra collar did not appear to bother the deer. To receive continuous heart-rate data from wild deer, either a sustaining collar must be employed or the implant's transmitting distance increased. The latter option would increase battery power needed and possibly the implant's size.

The second problem with the telemetry system was more severe and complex. During bedded, "quiet" standing, and "quiet" grazing activities ("quiet" meaning little body movement), heart-rate signal was received well. However, during "active" feeding, such as head-up, head-down motion in quick succession, or walking and running activities, heart-rate signal was erratic (Fig. 6). This indicated artifact (spurious electrical noise) was being interpreted as heart-pulses (R-waves) by the telemetry system and leading to erroneous heart-rate recordings. Further evidence of this problem occurred during bedded activities. Heart-rate signal was constant until the animal moved its head or foreleg which seemed to cause an instantaneous rise in heart-rate (Fig. 7). Because of the artifact problem, heart-rates for walking, running, and most grazing activities could not be obtained.

Causes of this artifact problem are unknown. Possible causes are electrical impulses created by: 1) muscle movement near the sternum, 2) slight movement of the implant and electrodes within the animal as the animal moves, and 3) electrode movement resulting in minute changes in distances between electrodes. Further developmental research must be undertaken to solve this problem or else accurate heart-rates for walking, running, and grazing activities cannot be obtained.



Fig. 3. Surgery to implant transmitter package, Top: electrodes initially fed into catheter, Center: electrodes ready to feed into catheter again, Bottom: suturing implant incision. (Photos by F. Waugh).

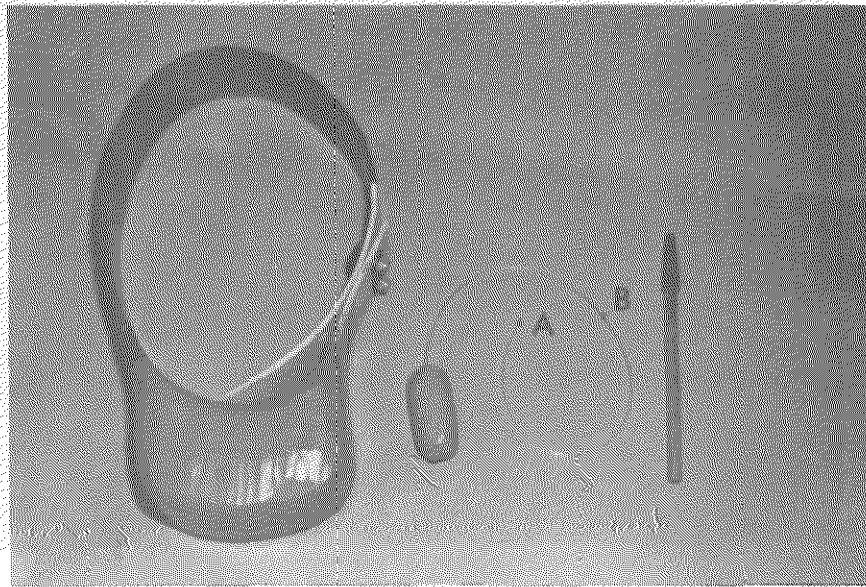


Fig. 1. Transceiver neck collar, left, and heart-pulse transmitter, right, used to monitor heart-rates of deer. Two stainless steel electrodes exit from transmitter within a protective teflon plastic tube and surface outside the tube (points A & B) to contact animal tissue. (Photo by F. Waugh).

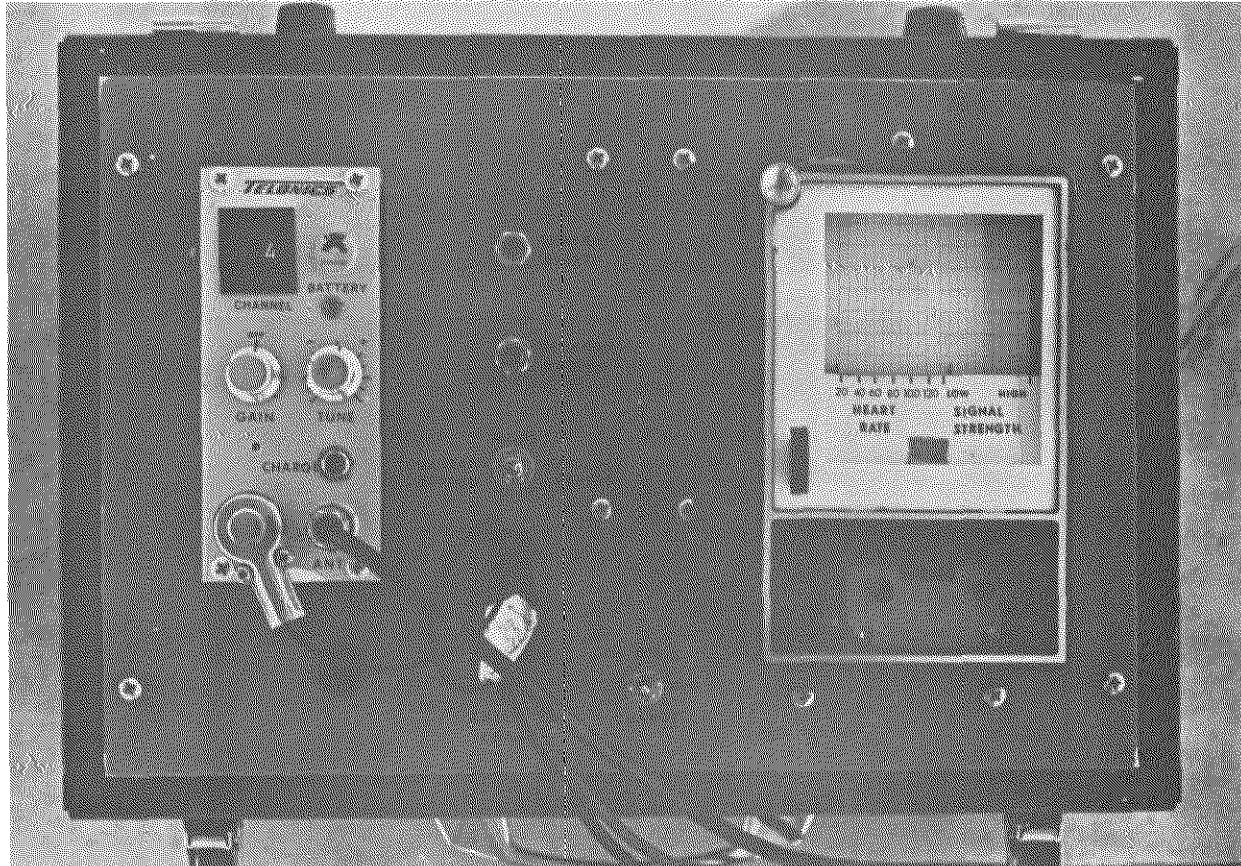


Fig. 2. Receiver and strip-chart recorder used to receive heart-rate signals.



Fig. 4. Tower used to monitor deer activities and heart-rates.

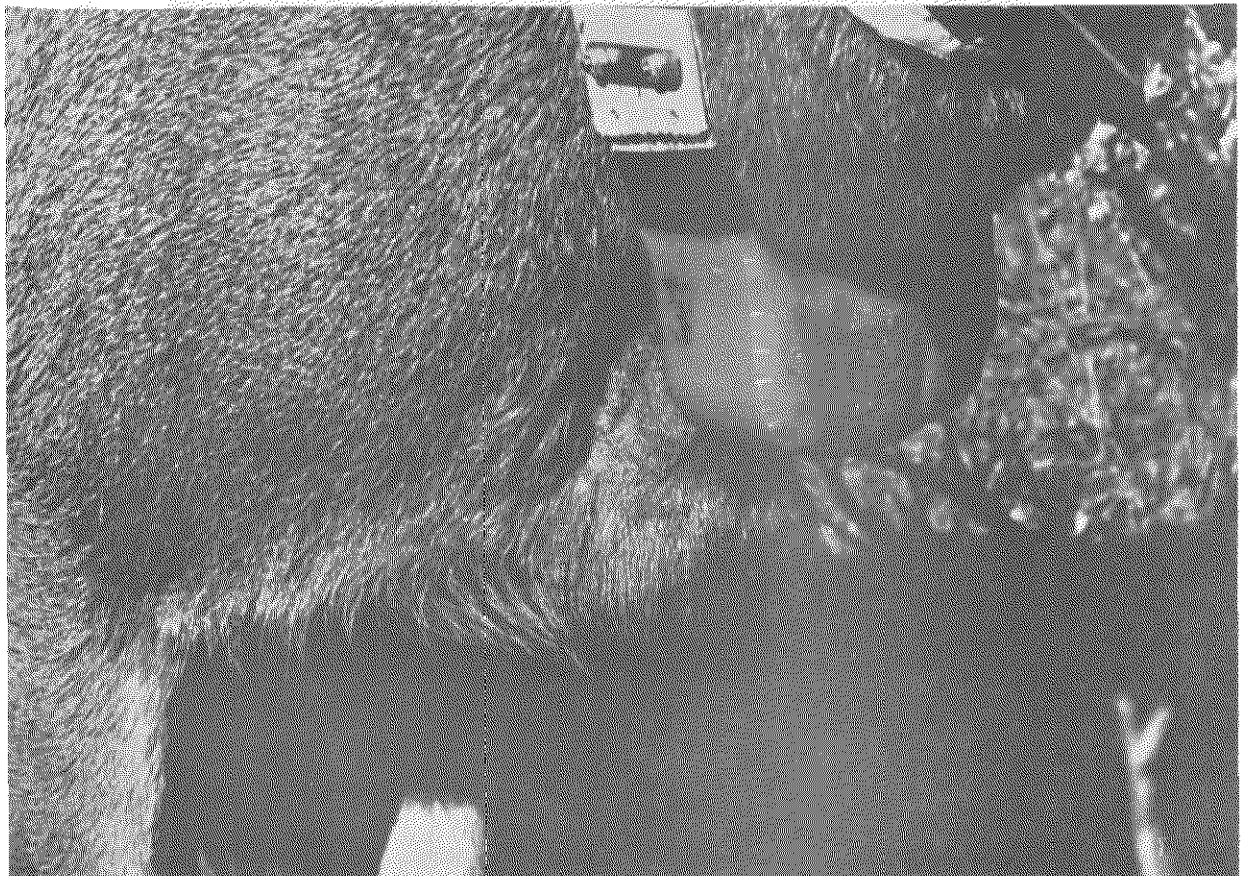


Fig. 5. Sustaining collar used to keep transceiver neck-collar close to implant. Implant located beneath shaved-hair area, bottom picture.

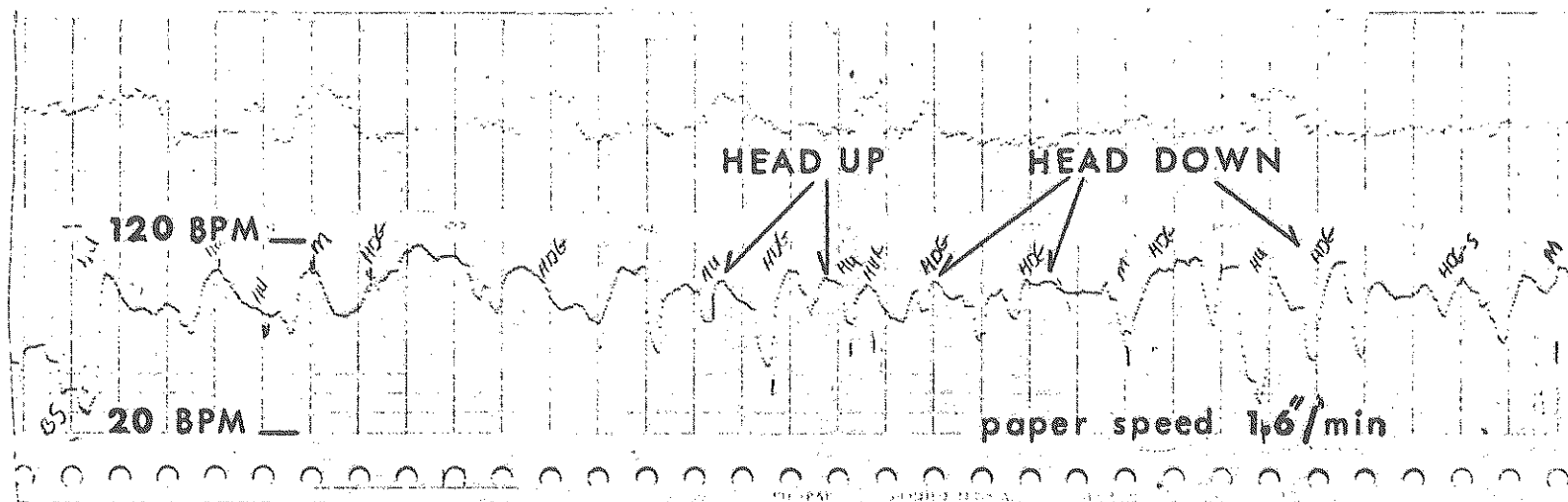


Fig. 6. Heart-rate trace of deer No. 39 during grazing activity showing variability in heart-rate probably due to artifact associated with head-up, head-down movement.

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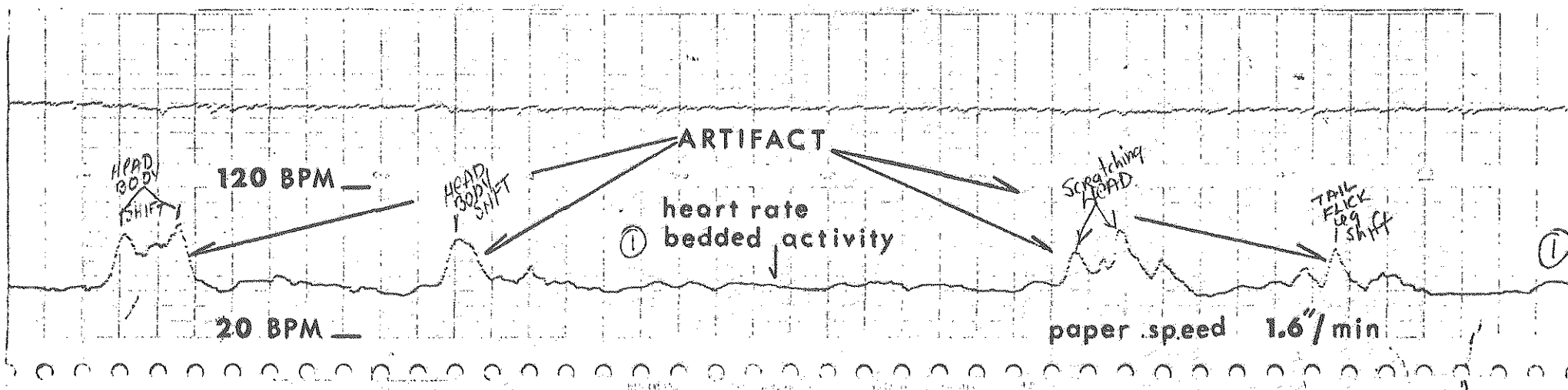


Fig. 7. Heart-rate trace of deer No. 39 during bedded activity showing increases in heart-rate due to artifact associated with body movement.

To measure the magnitude of artifact, an external ECG telemetry system (Kautz, unpublished data, Colo. State Univ. 1977) was affixed to one deer and both the external and internal heart-rate systems were monitored simultaneously. However, the external system also produced artifact during walking and grazing activities, preventing measurement of heart-rates for these activities. When the deer was standing quietly, the external system produced an excellent ECG waveform trace (Fig. 8). Through simultaneous monitoring the internal transmitter was found to be accurately pulsing for every "R wave" produced during a quiet stand activity.

Harassment trials were conducted in February and March. Forms of harassment tested were one person, two persons, and one person plus a German Shepherd dog walking, and a person riding a snowmobile over 6 routes ranging from 0 to 400 yards from the pasture. Successive routes were traveled on one day with a minimum of 10 minutes between routes. "Harassers" were out of sight of the deer while waiting to travel the next route. Duration of harassment ranged from 8-26 minutes. Animals were not actively pursued during harassment trials. Little or no snow was present during the trials.

Deer reacted to harassment with some degree of overt behavior during all trials except two (Table 1). Two persons walking 100 yards above the pasture elicited the strongest response from the deer. Deer reacted by running to the farthest corner of the pasture away from this harassment, and remained alert for at least 5 minutes after "harassers" were out of sight. A person walking with a dog appeared to have little effect on the deer (Table 1). Snowmobile activity brought varied responses from deer with severity of deer response apparently increasing with decreasing distance from the snowmobile (Table 1).

Increases in heart-rate could not be accurately measured if deer began to walk or run. However, on 3 occasions increases in heart-rate were apparent while deer were either standing still or bedded (Table 1, Fig. 9). These increases in heart-rate suggested that although deer may not elicit strong overt behavioral reactions to harassment, "flight" response mechanisms may be active, indicative of some degree of stress.

Visual contact by deer with forms of harassment preceded overt responses. These deer appeared to rely on sight more than smell or hearing as a defense mechanism.

This segment's work revealed problems with measuring heart-rate during certain deer activities, demonstrated that semi-tame deer at pasture will react to harassment, and that heart-rate may be a sensitive measure of non-overt reactions of deer to harassment.

Table 1. Reactions of deer to various types of harassment, Middle Park, Colorado, 1977.

Harassment	Date	Deer No.	Distance From Pasture	Overt Behavior Reaction	Apparent Increase In Heart Rate	Change In Deer Activity	Duration of Harassment (Minutes)
One Person Walking	2-21-77	39	300-400 yds	1 ^a	Yes	No	13 ^c
	2-21-77	18	200 yds	1	Yes	Yes	11
	2-21-77	39	100 yds	1	Yes	No	9 ^c
	2-21-77	18	0 yds	1	No	No	11
Two Persons Walking	3-07-77	18	300-400 yds	1	No	No	9
	3-07-77	39	200 yds	1	Yes	Yes	10
	3-07-77	18	100 yds	1	No	No	9
	3-07-77	39	0 yds	1	Yes	Yes	13
	3-07-77	18	0 yds ^b	0	No	No	8
Two Persons Walking	3-08-77	39	100 yds ^b	3	Yes	Yes	26
Person Plus Dog Walking	3-09-77	18	300-400 yds	1	No	No	9
	3-09-77	39	200 yds	1	Yes	No	10 ^c
	3-09-77	18	100 yds	1	No	No	10
Person On Snowmobile	3-18-77	39	300-400 yds	1	No	No	12
	3-18-77	18	100-300 yds	2	Yes	Yes	7
	3-18-77	39	0-1700 yds	1	No	Yes	23
Person On Snowmobile	3-19-77	18	300-400 yds	0	No	No	12
	3-19-77	39	0-400 yds	2	Yes	Yes	11

a

0 = no overt reaction; 1 = ears-up, alert appearance, no movement away from harassment; 2 = ears-up, alert appearance, moderate movement; 3 = ears-up, alert appearance, strong movement.

b

Route located elevationally above pasture.

c

Increases in heart-rate possibly indicate of "flight" response.

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